An Integrative Watershed Modeling Framework (IWMF) for Ecosystem Sustainability Assessment at the Watershed Scale

Author: Yusuf Mohamoud
U.S. EPA/Office of Research and Development (ORD)/National Exposure Research Laboratory (NERL)/Ecosystems Research Division

Keywords: land use planning, ecosystem services, hydrological alterations, sustainability, watershed models

The public's right to continued access and use of ecosystem services requires an evaluation of the environmental risks that are associated with activities such as urban development, agriculture, forestry, mining, water withdrawal, and dam construction. Human activities can cause hydrological alterations and other stressors that occur over time and interact with one another, resulting in combined and cumulative environmental effects on the ecosystem. Assessing the combined environmental effects of human activities, such as urban development and dam construction, on downstream water availability, quality, and demand and on channel morphology and biological integrity of aquatic ecosystems is a major challenge that affects the application of established assessment protocols, such as the Total Maximum Daily Load (TMDL) development process. One way to address the combined and cumulative environmental effects of urban development and water resources development jointly is to use comprehensive watershed models that can simulate the interactions between multiple stressors. Many watershed models and modeling approaches are not adequately comprehensive and do not address changes in water availability resulting from reduced base flow due to increased impervious cover or increased water withdrawal. This study presents a modeling approach or framework that would allow resource managers and decision-makers to link upstream development activities, particularly urban development and water resources development, to downstream environmental effects. The proposed integrative watershed modeling framework (IWMF) is an iterative and adaptive watershed modeling approach that is suitable for evaluating combined environmental effects associated with different land and water development scenarios and selection of specific development alternatives leading to sustainable use of ecosystem services. The proposed framework is based on the Hydrological Simulation Program- FORTRAN (HSPF) and has three main components: water availability (hydrological alterations), water quality (water quality alterations), and water demand (water allocation) simulation models.

Point of Contact:
Yusuf Mohamoud
Hydrologist
U.S. EPA/ORD/NERL
760 College Station
Athens, GA 30605
706-355-8109
mohamoud.yusuf@epa.gov